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CONTENTS:

Address of the President of the Section of Anthropology of the British Association for the Advancement of Science: PROFESSOR JOHNSON SYMINGTON 545

Scientific Books:—

The Alchemist: DR. HENRY CARRINGTON BOLTON. *Blatchley's Orthoptera of Indiana:* PROFESSOR F. M. WEBSTER 556

Scientific Journals and Articles 558

Societies and Academies:—

The New York Academy of Sciences; Section of Biology: PROFESSOR M. A. BIGELOW; *Section of Astronomy, Physics and Chemistry:* S. A. MITCHELL 559

Discussion and Correspondence:—

The International Congress of Arts and Sciences: PROFESSOR HUGO MÜNSTERBERG 559

Shorter Articles:—

A Plea for Better English in Science: P. C. WARMAN. *Contribution to the Craniology of the People of Scotland:* A. HRDLICKA. *Vertebrate Paleontology at the Carnegie Museum:* J. B. HATCHER 563

Ethnological and Archeological Survey of California 570

Scientific Notes and News 571

University and Educational News 576

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*ADDRESS OF THE PRESIDENT OF THE SECTION OF ANTHROPOLOGY OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.**

IT is now nearly twenty years since anthropology attained to the dignity of being awarded a special and independent section in this association, and I believe it is generally admitted that during this period the valuable nature of many of the contributions, the vigor of the discussions and the large attendance of members have amply justified the establishment and continued existence of this section.

While the multifarious and diverse nature of the subjects which are grouped under the term anthropology gives a variety and a breadth to our proceedings, which are very refreshing in this age of minute specialism, I feel that it adds very considerably to the difficulty of selecting a subject for a presidential address which will prove of general interest.

A survey of the recent advances in our knowledge of the many important questions which come within the scope of this section would cover too wide a field for the time at my disposal, while a critical examination of the various problems that still await solution might expose me to the temptation of pronouncing opinions on subjects regarding which I could not speak with any real knowledge or experience. To

* Southport meeting, 1903.

avoid such a risk I have decided to limit my remarks to a subject which comes within the range of my own special studies, and to invite your attention to a consideration of some problems arising from the variations in the development of the skull and the brain.

Since the institution of this section the development, growth and racial peculiarities of both skull and brain, and the relation of these two organs to each other, have attracted an ever-increasing amount of attention. The introduction of new and improved methods for the study of the structure of the brain and the activity of an able band of experimenters have revolutionized our knowledge of the anatomy and physiology of the higher nerve centers.

The value of the results thus obtained is greatly enhanced by the consciousness that they bear the promise of still greater advances in the near future. If the results obtained by the craniologists have been less marked, this arises mainly from the nature of the subject, and is certainly not due to any lack of energy on their part. Our craniological collections are continually increasing, and the various prehistoric skull-caps from the Neanderthal to the Trinil still form the basis of interesting and valuable memoirs.

While the additions to our general knowledge of cerebral anatomy and physiology have been so striking, those aspects of these subjects which are of special anthropological interest have made comparatively slight progress, and can not compare in extent and importance with the advantages based upon a study of fossil and recent crania. These facts admit of a ready explanation. Brains of anthropological interest are usually difficult to procure and to keep, and require the use of special and complicated methods for their satisfactory examination, while skulls of the leading races of mankind are readily collected, preserved and studied. Hence it follows that the crania in our anthropological collections are as numerous, well preserved and varied as the brains are few in number and defective, in their state of both preservation and representative character. It may reasonably be anticipated that improved methods of preservation and the growing recognition on the part of anthropologists, museum curators and collectors of the importance of a study of the brain itself will to some extent at least remedy these defects; but so far as prehistoric man is concerned, we can never hope to have any direct evidence of the condition of his higher nerve centers, and must depend for an estimate of his cerebral development upon those more or less perfect skulls which fortunately have resisted for so many ages the corroding hand of time.

I presume we will all admit that the main value of a good collection of human skulls depends upon the light which they can be made to throw upon the relative development of the brains of different races. Such collections possess few, if any, brains taken from these or corresponding skulls, and we are thus dependent upon the study of the skulls alone for an estimate of brain development.

Vigorous attacks have not unfrequently been made upon the craniometric systems at present in general use, and the elaborate tables, compiled with so much trouble, giving the circumference, diameters and corresponding indices of various parts of the skull, are held to afford but little information as to the real nature of skull variations, however useful they may be for purposes of classification. While by no means prepared to express entire agreement with these critics, I must admit that craniologists as a whole have concentrated their attention mainly on the external contour

of the skull, and have paid comparatively little attention to the form of the cranial cavity. The outer surface of the cranium presents features which are due to other factors than brain development, and examination of the cranial cavity not only gives us important information as to brain form, but by affording a comparison between the external and internal surfaces of the cranial wall it gives a valuable clue to the real significance of the external configuration. Beyond determining its capacity we can do but little towards an exact investigation of the cranial cavity without making a section of the skull. Forty years ago Professor Huxley, in his work 'On the Evidence of Man's Place in Nature,' showed the importance of a comparison of the basal with the vaulted portion of the skull, and maintained that until it should become 'an opprobrium to an ethnological collection to possess a single skull which is not bisected longitudinally' there would be 'no safe basis for that ethnological craniology which aspires to give the anatomical characters of the crania of the different races of mankind.' Professor Cleland and Sir William Turner have also insisted upon this method of examination, and only two years ago Professor D. J. Cunningham, in his presidential address to this section, quoted, with approval, the forcible language of Huxley. The curators of craniological collections appear, however, to possess an invincible objection to any such treatment of the specimens under their care. Even in the Hunterian Museum in London, where Huxley himself worked at this subject, among several thousands of skulls, scarcely any have been bisected longitudinally, or had the cranial cavity exposed by a section in any other direction. The method advocated so strongly by Huxley is not only essential to a thorough study of the relations of basi-cranial axis to the vault of the cranium and to the facial portion of the skull, but also permits of casts being taken of the cranial cavity; a procedure which, I would venture to suggest, has been too much neglected by craniologists.

Every student of anatomy is familiar with the finger-like depressions on the inner surface of the cranial wall, which are described as the impress of the cerebral convolutions; but their exact distribution and the degree to which they are developed according to age, sex, race, etc., still remain to be definitely determined. Indeed, there appears to be a considerable difference of opinion as to the degree of approximation of the outer surface of the brain to the inner surface of the cranial wall. Thus the brain is frequently described as lying upon a water-bed, or as swimming in the cerebro-spinal fluid, while Hyrtle speaks of this fluid as a 'ligamentum suspensorium' for the brain. Such descriptions are misleading when applied to the relation of the cerebral convolutions to the skull. There are, it is true, certain parts of the brain which are surrounded and separated from the skull by a considerable amount of fluid. These, however, are mainly the lower portions, such as the medulla oblongata and pons Varolii, which may be regarded as prolongations of the spinal cord into the cranial cavity. As they contain the centers controlling the action of the circulatory and respiratory organs, they are the most vital parts of the central nervous system, and hence need special protection. They are not, however, concerned with the regulation of complicated voluntary movements, the reception and storage of sensory impressions from lower centers, and the activity of the various mental processes. These functions we must associate with the higher parts of the brain, and

especially with the convolutions of the cerebral hemispheres.

If a cast be taken of the cranial cavity and compared with the brain which had previously been carefully hardened *in situ* before removal, it will be found that the cast not only corresponds in its general form to that of the brain, but shows a considerable number of the cerebral fissures and convolutions. This molding of the inner surface of the skull to the adjacent portions of the cerebral hemispheres is usually much more marked at the base and sides than over the vault. Since the specific gravity of the brain tissue is higher than that of the cerebro-spinal fluid, the cerebrum tends to sink towards the base and the fluid to accumulate over the vault; hence probably these differences admit of a simple mechanical explanation. Except under abnormal conditions, the amount of cerebro-spinal fluid between the skull and the cerebral convolutions is so small that from a cast of the cranial cavity we can obtain not only a good picture of the general shape and size of the higher parts of the brain, but also various details as to the convolutionary pattern. This method has been applied with marked success to the determination of the characters of the brain in various fossil lemurs by Dr. Forsyth Major and Professor R. Burckhardt, and Professor Gustav Schwalbe has made a large series of such casts from his craniological collection in Strassburg. The interesting observations by Schwalbe* on the arrangement of the 'impressiones digitatæ' and 'juga cerebralia,' and their relation to the cerebral convolutions in man, the apes and various other mammals, have directed special attention to a very interesting field of inquiry. As is well known, the marked prominence at the base of the human skull, separating the anterior from the middle fossa, fits into the deep cleft between the frontal and temporal lobes of the brain, and Schwalbe has shown that this ridge is continued—of course in a much less marked form—along the inner surface of the lateral wall of the skull, so that a cast of the cranial cavity presents a shallow but easily recognized groove corresponding to the portion of the Sylvian fissure of the brain separating the frontal and parietal lobes from the temporal lobe. Further, there is a distinct depression for the lodgment of the inferior frontal convolution, and a cast of the middle cranial fossa shows the three external temporal convolutions.

We must now turn to the consideration of the relations of the outer surface of the cranium to its inner surface and to the brain. This question has engaged the attention of experts as well as the 'man in the street' since the time of Gall and Spurzheim, and one might naturally suppose that the last word had been said on the subject. This, however, is far from being the case. All anatomists are agreed that the essential function of the cranium is to form a box for the support and protection of the brain, and it is generally conceded that during the processes of development and growth the form of the cranium is modified in response to the stimulus transmitted to it by the brain. In fact, it is brain growth that determines the form of the cranium, and not the skull that molds the brain into shape. This belief, however, need not be accepted without some reservations. Even the brain may be conceived as being influenced by its immediate environment. There are probably periods of development when the form of the brain is modified by the resistance offered by its coverings, and there are certainly stages

* 'Ueber die Beziehungen zwischen Innenform und Aussenform des Schädels,' *Deutsches Archiv für klinische Medicin*, 1902.

when the brain does not fully occupy the cranial cavity.

At an early period in the phylogeny of the vertebrate skull the structure of the greater part of the cranial wall changes from membranous tissue into cartilage, the portion persisting as membrane being situated near the median dorsal line. In the higher vertebrates the rapid and early expansion of the dorsal part of the fore-brain is so marked that the cartilaginous growth fails to keep pace with it, and more and more of the dorsal wall of the cranium remains membranous, and subsequently ossifies to form membrane bones. Cartilage, though constituting a firmer support to the brain than membrane, does not possess the same capacity of rapid growth and expansion. The head of a young child is relatively large, and its skull is distinguished from that of an adult by the small size of the cartilaginous base of the cranium as compared with the membranous vault. The appearance of top-heaviness in the young skull is gradually obliterated as age advances, by the cartilage continuing slowly to grow after the vault has practically ceased to enlarge. These changes in the shape of the cranium are associated with corresponding alterations in that of the brain, and it appears to me that we have here an illustration of how the conditions of skull growth may modify the general form of the brain.

Whatever may be the precise influences that determine skull and brain growth, there can be no doubt but that within certain limits the external form of the cranium serves as a trustworthy guide to the shape of the brain. Statements such as those by Dr. J. Deniker ('The Races of Man,' p. 53), 'that the inequalities of the external table of the cranial walls have no relation whatever to the irregularities of the inner table, and still less have anything in common with the configuration of the various parts of the brain,' are of too general and sweeping a character. Indeed, various observers have drawn attention to the fact that in certain regions the outer surface of the skull possesses elevations and depressions which closely correspond to definite fissures and convolutions of the brain. Many years ago Sir William Turner, who was a pioneer in cranio-cerebral topography, found that the prominence on the outer surface of the parietal bone, known to anatomists as the parietal eminence, was situated directly superficial to a convolution of the parietal lobe of the brain, which he consequently very appropriately named 'the convolution of the parietal eminence.' Quite recently Professor G. Schwalbe has shown that the position of the third or inferior frontal convolution is indicated by a prominence on the surface of the cranium in the anterior part of the temple. This area of the brain is of special interest to all students of cerebral anatomy and physiology, since it was the discovery by the illustrious French anthropologist and physician, M. Broca, that the left inferior frontal convolution was the center for speech, that laid the scientific foundation of our present knowledge of localization of function in the cerebral cortex. This convolution is well known to be much more highly developed in man than in the anthropoid apes, and the presence of a human cranial speech-bump is usually easily demonstrated. The faculty of speech, however, is such a complicated cerebral function that I would warn the 'new' phrenologist to be cautious in estimating the loquacity of his friends by the degree of prominence of this part of the skull, more particularly as there are other and more trustworthy methods of observation by which he can estimate this capacity.

In addition to the prominences on the

outer surface of the cranium, corresponding to the convolutions of the parietal eminence and the left inferior frontal convolution, the majority of skulls possess a shallow groove marking the position of the Sylvian point and the course of the horizontal limb of the Sylvian fissure. Below these, two other shallow oblique grooves indicate the line of the cerebral fissures which divide the outer surface of the temporal lobe into its three convolutions, termed superior, middle and inferior. Most of these cranial surface markings are partially obscured in the living body by the temporal muscle, but they are of interest as showing that in certain places there is a close correspondence in form between the external surface of the brain and that of the skull. There are, however, distinct limitations in the degree to which the various cerebral fissures and convolutions impress the inner surface of the cranial wall, or are represented by inequalities on its outer aspect. Thus over the vault of the cranium the position of the fissure of Rolando and the shape of the cerebral convolutions in the so-called motor area, which lie in relation to this fissure, can not usually be detected from a cast of the cranial cavity, and are not indicated by depressions or elevations on the surface of the skull, so that the surgeons in planning the seats of operations necessary to expose the various motor centers have to rely mainly upon certain linear and angular measurements made from points frequently remote from these centers.

The cranium is not merely a box developed for the support and protection of the brain, and more or less accurately molded in conformity with the growth of this organ. Its antero-lateral portions afford attachments to the muscles of mastication and support the jaws and teeth, while its posterior part is liable to vary according to the degree of development of the muscles of the nape of the neck. Next to the brain the most important factor in determining cranial form is the condition of the organs of mastication—muscles, jaws and teeth. There is strong evidence in favor of the view that the evolution of man from microcephaly to macrocephaly has been associated with the passages from macrodontic to a microdontic condition. The modifications in the form of the cranium due to the influence of the organs of mastication have been exerted almost entirely upon its external table; hence external measurements of the cranium, as guides to the shape of the cranial cavity and indications of brain development, while fairly trustworthy in the higher races, become less and less so as we examine the skulls of the lower races, of prehistoric man and of the anthropoid apes.

One of the most important measurements of the cranium is that which determines the relation between its length and breadth and thus divides skulls into long or short, together with an intermediate group neither distinctly dolichocephalic nor brachycephalic. These measurements are expressed by an index in which the length is taken as 100. If the proportion of breadth to length is eighty or upwards, the skull is brachycephalic; if between seventy-five and eighty, mesaticephalic; and below seventy-five, dolichocephalic. Such a measurement is not so simple a matter as it might appear at first sight, and craniologists may themselves be classified into groups according as they have selected the nasion, or depression at the root of the nose, the glabella, or prominence above this depression, and the ophryon, a spot just above this prominence, as the anterior point from which to measure the length. In a young child this measurement would practically be the same, whichever of these

three points was chosen, and each point would be about the same distance from the brain. With the appearance of the teeth of the second dentition and the enlargement of the jaws the frontal bone in the region of the eyebrows and just above the root of the nose thickens, and its outer table bulges forward so that it is now no longer parallel with the inner table. Between these tables air cavities gradually extend from the nose, forming the frontal sinuses. Although the existence and significance of these spaces and their influence on the prominence of the eyebrows were the subject of a fierce controversy more than half a century ago between the phrenologists and their opponents, it is only recently that their variations have been carefully investigated.

The frontal sinuses are usually supposed to vary according to the degree of prominence of the glabella and the supra-orbital arches. This, however, is not the case. Thus Schwalbe* has figured a skull in which the sinuses do not project as high as the top of the glabella and supra-orbital prominences, and another in which they extend considerably above these projections. Further, Dr. Logan Turner ('The Accessory Sinuses of the Nose,' 1901), who has made an extensive investigation into these cavities, has shown that in the aboriginal Australian, in whom this region of the skull is unusually prominent, the frontal sinuses are frequently either absent or rudimentary. The ophryon has been selected by some craniologists as the anterior point from which to measure the length of the skull, under the impression that the frontal sinuses do not usually reach above the glabella. Dr. Logan Turner, however, found that out of 174 skulls in which the frontal sinuses were present, in 130 the sinuses extended above the ophryon. In 71 skulls the depth of the sinus at the level of the ophryon varied from 2 mm. to 16 mm., the average being 5.2 mm., while in the same series of skulls the depth at the glabella varied from 3 mm. to 18 mm., with an average depth of 8.5 mm. It thus appears that the selection of the ophryon in preference to the glabella, as giving a more accurate clue to the length of the brain, is based upon erroneous assumptions, and that neither point can be relied upon in the determination of the anterior limit of the cranial cavity.

The difficulties of estimating the extent of the cranial cavity by external measurements and the fallacies that may result from a reliance upon this method are especially marked in the case of the study of the prehistoric human calvaria, such as the Neanderthal and the Trinil, and the skulls of the anthropoid apes.

Statistics are popularly supposed to be capable of proving almost anything, and certainly if you allow craniologists to select their own points from which to measure the length and breadth of the cranium, they will furnish you with tables of measurements showing that one and the same skull is dolichocephalic, mesaticephalic and brachycephalic. Let us take as an illustration an extreme case, such as the skull of an adult male gorilla. Its glabella and supra-orbital arches will be found to project forward, its zygomatic arches outwards, and its transverse occipital crests backwards, far beyond the anterior, lateral and posterior limits of the cranial cavity. These outgrowths are obviously correlated with the enormous development of the muscles of mastication and those of the back of the neck. In a specimen in my possession the greatest length of the cranium, *i. e.*, from glabella to external occipital protuberance, is 195 mm., and the greatest

* 'Studien über *Pithecanthropus erectus*,' *Zeitschrift für Morphologie und Anthropologie*, Bd. I., 1899.

breadth, taken between the outer surfaces of the zygomatic processes of the temporal bone, is 172 mm., giving the marked brachycephalic index of 88.21. The zygomatic processes, however, may reasonably be objected to as indicating the true breadth, and the side wall of the cranium just above the line where the root of this process springs from the squamous portion of the temporal bone will certainly be much nearer the cranial cavity. Measured in this situation, the breadth of the cranium is 118 mm., which gives a length-breadth index 60.51, and thus represents the skull as decidedly dolichocephalic. The transverse occipital crests and the point where these meet in the middle line to form the external occipital protuberance are much more prominent in the male than in the female gorilla, and the estimate of the length of the cranium in this male gorilla may be reduced to 160 mm. by selecting the base of the protuberance in place of its posterior extremity as the posterior end measurement. This raises the index to 73.75, and places the skull near the mesaticephalic group. At the anterior part of the skull the prominent glabella is separated from the inner table of the skull by large air sinuses, so that on a median section of the skull the distance from the glabella to the nearest part of the cranial cavity is 36 mm. We have here, therefore, another outgrowth of the cranial wall which in an examination of the external surface of the skull obscures the extent of the cranial cavity. Accordingly the glabella can not be selected as the anterior point from which to measure the length of the cranium, and must, like the zygomatic arches and occipital protuberance, be excluded from our calculations if we desire to determine a true length-breadth index. The difficulty, however, is to select a definite point on the surface of the cranium to represent its anterior end, which will be free from the objections justly urged against the glabella. Schwalbe suggests the hinder end of the supra-glabellar fossa, which he states often corresponds to the beginning of a more or less distinctly marked frontal crest. I have found this point either difficult to determine or too far back. Thus in my male gorilla the posterior end of this fossa formed by the meeting of the two temporal ridges was 56 mm. behind the glabella, and only 24 mm. from the bregma, while in the female gorilla the temporal ridges do not meet, but there is a low median frontal ridge, which may be considered as bounding posteriorly the supra-glabellar fossa. This point is 22 mm. from the glabella, and between 50 mm. and 60 mm. in front of the bregma.

I would suggest a spot in the median line of the supra-glabellar fossa which is crossed by a transverse line uniting the posterior borders of the external angular processes of the frontal bone. I admit this plan is not free from objections, but it possesses the advantages of being available for both male and female skulls. In my male skull the selection of this point diminishes the length of the cranium by 25 mm., thus reducing it to 137 mm. The breadth being calculated at 114 mm., the index is 83.21, and hence distinctly brachycephalic. The length of the cranial cavity is 118 mm. and the breadth 96 mm., and the length-breadth index is thus the brachycephalic one of 81.36.

I have given these somewhat detailed references to the measurements of this gorilla's skull because they show in a very clear and obvious manner that from an external examination of the skull one might easily be misled as to the size and form of the cranial cavity, and that, in order to determine from external measurements the proportions of the cranial cavity, skul!

outgrowths due to other factors than brain growth must be rigorously excluded. Further, these details will serve to emphasize the interesting fact that the gorilla's skull is decidedly brachycephalic. This character is by no means restricted to the gorilla, for it has been clearly proved by Virchow, Schwalbe and others that all the anthropoid apes are markedly round-headed. Ever since the introduction by the illustrious Swedish anthropologist Anders Retzius of a classification of skulls according to the proportions between their length and breadth, great attention has been paid to this peculiarity in different races of mankind. It has been generally held that brachycephaly indicates a higher type of skull than dolichocephaly, and that the increase in the size of the brain in the higher races has tended to produce a brachycephalic skull. When the cranial walls are subject to excessive internal pressure, as in hydrocephalus, the skull tends to become distinctly brachycephalic, as a given extent of wall gives a greater internal cavity in a spherical than in an oval form. In estimating the value of this theory as to the evolutionary line upon which the skull has traveled, it is obvious that the brachycephalic character of the skulls of all the anthropoid apes is a fact which requires consideration.

Although an adult male gorilla such as I have selected presents in an extreme degree outgrowths from the cranial wall masking the true form of the cranial cavity, the same condition, though to a less marked extent, is met with in the human subject. Further, it is interesting to note that the length of the skull is more liable to be increased by such growths than the breadth, since they occur especially over the lower part of the forehead and to a less degree at the back of the skull, while the side walls of the cranium in the region of its greatest breadth generally remain thin.

Few, if any, fossils have attracted an equal amount of attention or given rise to such keen controversies as the Neanderthal and the Trinil skull-caps. According to some authorities, both these skull-caps are undoubtedly human, while others hold that the Neanderthal belongs to an extinct species of the genus *Homo,* and the Trinil is the remains of an extinct genus—*Pithecanthropus erectus* of Dubois—intermediate between man and the anthropoids. One of the most obvious and easily recognized peculiarities of these skull-caps is the very marked prominence of the supra-orbital arches. The glabella-occipital length of the Neanderthal is 204 mm., and the greatest transverse diameter, which is over the parietal region, is 152 mm.—an index of 74.51—while the much smaller Trinil calvaria, with a length of 181 mm. and a breadth of 130 mm., has an index of 71.8. Both these skulls are therefore slightly dolichocephalic. Schwalbe has corrected these figures by making reductions in their lengths on account of the frontal 'outworks,' so that he estimates the true length-breadth index of the Neanderthal as 80 and that of the Trinil as 75.5. These indices, thus raised about 5 per cent., are considered to represent approximately the length-breadth index of the cranial cavity. A comparison of the external and internal measurements of many recent skulls with prominent glabellæ would, I suspect, show a greater difference than that calculated by Schwalbe for the Neanderthal and Trinil specimens. In a male skull, probably an aboriginal Australian, with a cranial capacity of 1227 c.cm. I found that the glabella-occipital length was 189 mm., and the transverse diameter at the parieto-squamous suture 127 mm., which gives an index of 67.20 and makes the skull de-

cidedly dolichocephalic. The length of the cranial cavity, however, was 157 mm. and the breadth 121 mm. (an index of 77.07 and a difference of nearly 10 per cent.), so that while from external measurements the skull is distinctly dolichocephalic, the proportions of its cavity are such that it is mesaticephalic. It is probable that many skulls owe their dolichocephalic reputation simply to the prominence of the glabella and supra-orbital ridges. An excessive development of these structures is also liable to give the erroneous impression of a retreating forehead. In the Australian skull just mentioned the thickness of the cranial wall at the glabella was 22 mm.; from this level upwards it gradually thinned until 45 mm. above the glabella it was only 6 mm. thick. When the bisected skull was placed in the horizontal position the anterior surface of the frontal bone sloped from the glabella upwards and distinctly backwards, while the posterior or cerebral surface was inclined upwards and forwards. In fact, the cranial cavity in this region was separated from the lower part of the forehead by a wedge-shaped area having its apex upwards and its base below at the glabella.

The cranial wall opposite the glabella is not appreciably thicker in the Neanderthal calvaria than in the Australian skull to which I have already referred, and the form of the cranial cavity is not more masked by this prominence in the Neanderthal than in many of the existing races.

Although the Neanderthal skull is by no means complete, the base of the cranium and the face bones being absent, still those parts of the cranial wall are preserved that are specially related to the portion of the brain which subserves all the higher mental processes. It includes the frontal, parietal and upper part of the occipital bones, with parts of the roof of the orbits in front, and of the squamous division of the temporal bones at the sides. On its inner or cranial aspect there are markings by which the boundaries between the cerebrum and the cerebellum can be determined. In a profile view of such a specimen an inio-glabellar line can be drawn which will correspond very closely to the lower boundary of the cerebrum, and indicate a horizontal plane above which the vaulted portion of the skull must have contained nearly the whole of the cerebrum.

Schwalbe* has devised a series of measurements to illustrate what he regards as essential differences between the Neanderthal skull-cap and the corresponding portion of the human skull. From the inio-glabellar line another is drawn at right angles to the highest part of the vault, and by comparing the length of these two lines we can determine the length-height index. According to Schwalbe, this is 40.4 in the Neanderthal, while the minimum in the human skull is 52. He further shows that the frontal portion of the vault, as represented by a glabellar-bregmatic line, forms a smaller angle with the base or inio-glabellar line, and that a vertical line from the posterior end of the frontal bone (bregma) cuts the inio-glabellar further back than in the human subject. Professor King, of Galway, attached special importance to the shape and proportions of the parietal bones, and more particularly to the fact that their mesial borders are shorter than the lower or temporal, whereas the reverse is the case in recent man. This feature is obviously related to the defective expansion of the Neanderthal vault, and Professor Schwalbe also attributes considerable significance to this peculiarity.

Another distinctive feature of the Ne-

* 'Ueber die specifischen Merkmale des Neanderthalschädels,' *Verhandl. der anatomischen Gesellschaft in Bonn*, 1901.

anderthal skull is the relation of the orbits to the cranial wall. Schwalbe shows that its brain-case takes a much smaller share in the formation of the roof of the orbit than it does in recent man, and King pointed out that a line from the anterior inferior angle of the external orbital process of the frontal bone, drawn at right angles to the inio-glabellar line, passed in the Neanderthal in front of the cranial cavity, whereas in man such a line would have a considerable portion of the frontal part of the brain-case anterior to it.

From the combined results of these and other measurements Schwalbe arrives at the very important and interesting conclusion that the Neanderthal skull possesses a number of important peculiarities which differentiate it from the skulls of existing man, and show an approximation towards those of the anthropoid apes. He maintains that in recognizing with King* and Cope† the Neanderthal skull as belonging to a distinct species, *Homo neanderthalensis*, he is only following the usual practice of zoologists and paleontologists, by whom specific characters are frequently founded upon much less marked differences. He maintains that as the Neanderthal skull stands in many of its characters nearer to the higher anthropoids than to recent man, if the Neanderthal type is to be included under the term *Homo sapiens*, then this species ought to be still more extended, so as to embrace the anthropoids.

It is interesting to turn from a perusal of these opinions recently advanced by Schwalbe to consider the grounds on which Huxley and Turner, about forty years ago, opposed the view, which was then being advocated, that the characters of the Neanderthal skull were so distinct from those of any of the existing races as to justify the recognition of a new species of the genus *Homo*. Huxley, while admitting that it was 'the most pithecoid of human skulls,' yet holds that it 'is by no means so isolated as it appears to be at first, but forms in reality the extreme term of a series leading gradually from it to the highest and best developed human crania.' He states that 'it is closely approached by certain Australian skulls and even more nearly by the skulls of certain ancient people who inhabited Denmark during the stone period.' Turner's* observations led him to adopt a similar view to that advanced by Huxley. He compared the Neanderthal calvaria with savage and British crania in the Anatomical Museum of the University of Edinburgh, and found amongst them specimens closely corresponding to the Neanderthal type.

While yielding to no one in my admiration for the thoroughness and ability with which Schwalbe has conducted his elaborate and extensive investigations on this question, I must confess that in my opinion he has not sufficiently recognized the significance of the large cranial capacity of the Neanderthal skull in determining the zoological position of its owner, or made sufficient allowance for the great variations in form which skulls undoubtedly human may present.

The length and breadth of the Neanderthal calvaria are distinctly greater than in many living races, and compensate for its defect in height, so that it was capable of lodging a brain fully equal in volume to that of any existing savage races and at least double that of any anthropoid ape.

A number of the characters upon which Schwalbe relies in differentiating the Neanderthal skull-cap are due to an appreci-

* 'The Reputed Fossil Man of the Neanderthal,' *Journal of Science*, 1864.

† 'The Genealogy of Man,' *The American Naturalist*, Vol. XXVII., 1893.

* 'The Fossil Skull Controversy,' *Journal of Science*, 1864.

able extent to the great development of the glabella and supra-orbital arches. Now these processes are well known to present very striking variations in existing human races. They are usually supposed to be developed as buttresses for the purpose of affording support to the large upper jaw and enable it to resist the pressure of the lower jaw due to the contraction of the powerful muscles of mastication. These processes, however, are usually feebly marked in the microcephalic, prognathous and macrodont negro skull, and may be well developed in the macrocephalic and orthognathous skulls of some of the higher races. Indeed, their variations are too great and their significance too obscure for them to form a basis for the creation of a new species of man. Both Huxley and Turner have shown that the low vault of the Neanderthal calvaria can be closely paralleled by specimens of existing races.

If the characters of the Neanderthal calvaria are so distinctive as to justify the recognition of a new species, a new genus ought to be made for the Trinil skull-cap. In nearly every respect it is distinctly lower in type than the Neanderthal, and yet many of the anatomists who have expressed their opinion on the subject maintain that the Trinil specimen is distinctly human.

Important and interesting as are the facts which may be ascertained from a study of a series of skulls regarding the size and form of the brain, it is evident that there are distinct limits to the knowledge to be obtained from this source. Much additional information as to racial characters would undoubtedly be gained had we collections of brains at all corresponding in number and variety with the skulls in our museums. We know that as a rule the brains of the less civilized races are smaller, and the convolutions and fissures simpler, than those of the more cultured nations; beyond this but little more is definitely determined.

As the results of investigations in human and comparative anatomy, physiology and pathology, we know that definite areas of the cerebral cortex are connected with the action of definite groups of muscles, and that the nervous impulses starting from the organs of smell, sight, hearing and common sensibility reach defined cortical fields. All these, however, do not cover more than a third of the convoluted surface of the brain, and the remaining two thirds are still to a large extent a *terra incognita* so far as their precise function is concerned. Is there a definite localization of special mental qualities or moral tendencies, and if so, where are they situated? These are problems of extreme difficulty, but their interest and importance are difficult to exaggerate. In the solution of this problem anthropologists are bound to take an active and important part. When they have collected information as to the relative development of the various parts of the higher brain in all classes of mankind with the same thoroughness with which they have investigated the racial peculiarities of the skull, the question will be within a measurable distance of solution.

JOHNSON SYMINGTON.

SCIENTIFIC BOOKS.

The Alchemist. By BEN JONSON, edited with introduction, notes and glossary by CHARLES MONTGOMERY HATHAWAY, JR. New York, Henry Holt & Co. 1903. Pp. vi + 373. 8vo.

This comedy was first produced in 1610, and proved a most severe satire on alchemy and an effective exposure of many of the swindles associated with it; in this satisfactory edition Dr. Hathaway has given his readers a text based on the folio of 1616, together with variants of several other early and rare editions.

Prefixed to the text are sections on the history and on the theory of alchemy; these

include its status in England at the period of the production of the play and narratives showing its adaptability to swindling credulous persons at all periods. The editor then points out the originality of Jonson and his slight indebtedness to previous writers; he also draws a picture of Simon Forman, a notorious London quack flourishing in Jonson's day, who probably furnished the author one of the characters of the play (Subtle).

The editor gives many instances of the swindling operations in recent times by pretended alchemists, especially dwelling on the tricks of Morrell and Harris in New York, of Pinter in London, and of the Rev. Mr. Jernegan, of Connecticut (in connection with the fraudulent extraction of gold from sea water), and he gives references to the daily press for particulars. Elsewhere he names the three principal branches of astrology and refers to some of the modern aspects of this pseudo science. In a note on Jonson 'taking in of shaddows with a glass' he writes of catoptiomancy, and refers to the notorious Kelley who acted as 'skryer' for Dr. Dee, in Queen Elizabeth's day.

Following the text are one hundred pages of notes, partly taken from preceding editions, notably Gifford and Whalley; a bibliography of works consulted, in which one misses the names of Hermann Kopp ('Geschichte der Chemie,' 4 vols., 1843, 'Die Alchemie in älterer und neuerer Zeit,' 2 vols., 1886), of William Johnson ('Lexicon chymicum,' London, 1652), and the 'Chymicall Dictionary,' bound with Michael Sandivogius' 'New Light of Alchemie' (London, 1650), but perhaps these were not accessible to Dr. Hathaway.

There is also a glossary of forty columns, and finally an index. Each section is marked by thorough work and painstaking study on the part of the editor; the glossary in particular may be of much assistance in explaining archaic and obsolete terms in the alchemical writings of other authors than Jonson.

The notes refer to passages in a variety of languages, show judicious selection and a wide acquaintance with literature. The deep study of alchemical jargon has familiarized the editor with incomprehensible gibberish to such an extent that he himself is not always perfectly clear. (See note on page 288, last three lines.) And he is sometimes tempted to substitute conjectures for more definite information, especially in discussing the signification of impossible words.

Dr. Hathaway shows the relations which Jonson's comedy bears to John Lyly's 'Gallathea,' printed in 1592, to Gower's and Chaucer's well-known poems, to Lydgate's 'Secrees of old Philisoffers' and to the principal metrical treatises on alchemy preserved by Elias Ashmole in his 'Theatrum Chemicum Britannicum' (London, 1652), from which he gives many citations.

The editor has been very successful in demonstrating that 'Nothing in Jonson is done at random.' The whole work is creditable to the editor, and for its typographical excellence to the publisher.

HENRY CARRINGTON BOLTON.

BLATCHLEY'S ORTHOPTERA OF INDIANA.

IN the Twenty-seventh Annual Report of the Department of Geology and Natural Resources of Indiana, 1902, Mr. W. S. Blatchley, State Geologist, has devoted over 350 pages to the Orthoptera of his state, and under this modest title has given us one of the best pieces of entomological work that has come to us during the present year. Not only are all of the species known to the author to occur in the state fully described, some of them for the first time, but he has given in connection therewith every scrap of information relating to them that he has been able to obtain, either by observation, correspondence or found recorded in entomological literature. The list includes 148 species, many of which are figured, the illustrations consisting of 121 figures, one colored and two uncolored plates, which with a full bibliography and synonymy, keys to families, genera and species found in Indiana, sections relating to the external anatomy of the order, natural enemies, life zones of Indiana, a glossary of terms used in the text, together with a full index, gives the work a

finish that is seldom found in connection with such papers. The author has himself studied the orthoptera of his state in the field, during the last twenty years, and many of the statements given relative to habits have come first hand fresh from the observer. The student of geographical distribution will find much of interest, while even those not especially interested in the technical descriptions will certainly not fail to appreciate the copious notes on habits, abundance, etc., etc., but it will be of the greatest value to those who make a specialty of the orthoptera.

F. M. Webster.

Urbana, Illinois,
September 30, 1903.

SCIENTIFIC JOURNALS AND ARTICLES.

The closing (October) number of volume 4 of the *Transactions of the American Mathematical Society* contains the following papers: 'On the subgroups of order a power of p in the quaternary abelian group in the Galois field of order p^n,' by L. E. Dickson; 'On the order of linear homogeneous groups,' by H. F. Blichfeldt; 'Non-abelian groups in which every subgroup is abelian,' by G. A. Miller and H. C. Moreno; 'On nilpotent algebras,' by J. B. Shaw; 'On solutions of differential equations which possess an oscillation theorem,' by Helen A. Merrill; 'On the reducibility of linear groups,' by L. E. Dickson; 'Semireducible hypercomplex number systems,' by S. Epsteen; 'A symbolic treatment of the theory of invariants of quadratic differential quantics of n variables,' by H. Maschke; 'Congruences of curves,' by L. P. Eisenhart; 'Similar conics through three points,' by T. J. I'a Bromwich.

The opening (October) number of volume 10 of the *Bulletin* of the Society contains the following papers: 'Poincaré's Review of Hilbert's Foundations of Geometry,' translated by E. V. Huntington; 'On linear differential congruences,' by S. Epsteen; 'Fields whose elements are linear differential expressions,' by L. E. Dickson; 'On directrix curves of quintic scrolls,' by C. H. Sisam; 'Josiah Willard Gibbs, Ph.D., LL.D., a short sketch and appreciation of his work in pure mathematics,' by P. F. Smith; Notes; New Publications.

The November number of the *Bulletin* contains: 'Report of the tenth summer meeting of the American Mathematical Society,' by F. N. Cole; 'Report of the committee of the American Mathematical Society on definitions of college entrance requirements'; 'On the congruence $x_{\phi(P)} \equiv 1$, mod. P^n,' by J. Westlund; Review of Mach's Mechanics, by E. B. Wilson; Review of Forsyth's Differential Equations, by E. J. Wilczynski; Notes; New Publications.

The Journal of the Franklin Institute prints, in its October number, the paper of Mr. Thomas M. Gardner, instructor in Sibley College, on 'The Graphics of Carbon-Disulphide, with Formulas and Vapor-Table.'

It is a practically important contribution to the literature of the subject, as it provides the essential entropy-values of a substance which is thought by some authorities to be likely to have importance as the working fluid of a secondary heat-motor, as in the 'waste-heat engines.'

A plate is given exhibiting the properties of the substance having importance in the thermodynamic operations, and another giving the temperature-entropy diagram with MacFarlane Gray's constant-volume lines. Several other plates present the constant-area lines, $pv = C$, the constant-quality lines, $x = C$, the constant-entropy lines, $\phi = C$; and the general temperature-entropy diagram, after Boulvin, completes the series.

A new and extensive table of the properties of the saturated vapor, in the form of the standard steam-tables, provides data hitherto uncomputed and in forms suitable to the thermodynamic discussion of heat-engines employing this substance. The values of n, also, in $pv^n = C$ are determined and the curve is given for adiabatic expansion of qualities ranging from $x = 0.10$ to $x = 1$.

It is shown that, with hyperbolic expansion, the 'quality' of wet fluid improves, the proportion of moisture decreasing; with superheated vapor, this expansion becomes isother-

mal, as with all gases, and all heat supplied is utilized as external work. The constant-quality curves have the equation $pv^{1.0568} = C$. With adiabatic expansion, the quality improves with all mixture in which $x < 0.6$ and the fluid progressively condenses for mixtures of initially $x = 0.7$ and above. The value of n is found to be

$$n = \left(\frac{x}{c}\right)^{\frac{1}{6.36}}; \; xn^{-6.36} = C;$$

the logarithmic curve is given, graphically illustrating the law of variation of n.

The specific volume of CS_2 is 2.6258 times that of air. Its boiling point is, according to Thorpe and Freidburg, 115.88 *F.* and its critical temperature is 504.5° *F.*, at a pressure of about 65 atmospheres.

The paper is one of special value and is the outcome, in part, of work for the Ph.D. at Cornell. R. H. T.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES. SECTION OF BIOLOGY.

THE first meeting of the academic year was held at the American Museum of Natural History on October 12, Professor Wilson acting as temporary chairman. As in former years, this first meeting after the long vacation was devoted to reports on scientific work carried on by members of the section during the summer. The following notes indicate the lines of the work of the members who reported.

Professor Bristol, in association with Professor Mark, of Harvard, directed the summer work at the Bermuda Biological Station. Dr. Hay was very successful in collecting in Wyoming materials for his studies of fossil turtles. Professor Osborn directed explorations in Wyoming, Nebraska and South Dakota in the interest of the American Museum of Natural History, securing much valuable material which supplements collections previously made. Professor Grabau collected in Michigan materials for continuation of his studies on Devonian faunas. Dr. Summer directed the Biological Laboratory of the United States Fish Commission at Woods Hole, Mass. Professor Calkins studied the relation of Protozoa to cancer and smallpox. Professor Crampton continued the accumulation of data relating to selection in Lepidoptera. Mr. Bigelow studied the early embryology of some crustaceans. Mr. Yatsu experimented on regulation and organization of nemertean eggs. Professor Wilson at Naples studied problems of localization and mosaic development of molluscan eggs.

M. A. BIGELOW,
Secretary.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

AT the meeting of the section on October 5, Professor Harold Jacoby and Dr. S. Alfred Mitchell exhibited a combined prismatic transit and zenith telescope. This instrument, just received by the Department of Astronomy of Columbia University, was made by Bamberg of Berlin. It includes all the latest observational devices, including an eye-piece of the Repsold pattern for the automatic registration of transit observations.

Dr. George F. Kunz and Dr. Charles Baskerville gave an exhibition of radium of 300,000 activity, with some notes on the action of the Roentgen ray, ultra-violet light and radium on mineralogical substances. This paper will be published elsewhere in SCIENCE.

S. A. MITCHELL,
Secretary of Section.

DISCUSSION AND CORRESPONDENCE.

THE INTERNATIONAL CONGRESS OF ARTS AND SCIENCE.

TO THE EDITOR OF SCIENCE: I returned only a few days ago from Europe and, therefore, have not seen until now the letter of Professor Dewey in SCIENCE of August 28 and that of Professor Woodward in SCIENCE of September 4, both of which deal with the International Congress of Arts and Science and especially with my essay on that congress, published in the May number of the *Atlantic Monthly*.

Professor Woodward's document gives me hardly a chance for a reply, since I can not see that it contains an argument. It is only a general expression of his contempt, on principle, for every effort to classify sciences from

a logical point of view. "While we may not go out of our way," he says, "to oppose philosophers and literary folk who indulge in such extravagances, it is our duty to repudiate them when they appear in the public press in the guise of science; for they tend only to make science and scientific men ridiculous." It may appear surprising if my chief aim was to make science ridiculous for the amusement of literary folk, that I took my medical degrees and have since been conducting scientific laboratories. But the worst of it is that those 'philosophers and literary folk' who have indulged in the acceptance of a program 'which bordered on absurdity' are the president of the congress, Professor Simon Newcomb, Mr. Pritchett, the president of the Massachusetts Institute of Technology, and others who were up to this time believed to have a certain interest in 'science'—for Professor Woodward is mistaken if he doubts that the program and classification which he saw has the endorsement of the entire committee. But the kind criticism of Professor Woodward requires the less discussion as he is also mistaken in his second presupposition. He thinks that the classification of sciences which has been accepted for the International Congress was sketched in my article for the purpose of inviting criticism of the scheme. That was not the case. It was merely a communication concerning a settled arrangement, fully discussed and definitely voted by the proper authorities. If I had been longing for criticism, I should hardly have published it in a form which offers merely results and not reasons; and however 'absurd and ridiculous' my system may be, I have at least never evaded the duty to give the reasons and arguments for my positions. A 'scientific man' can not of course read what philosophers and literary folk are writing; otherwise, I might refer him to the first volume of my 'Grundzuege der Psychologie,' in which about 500 pages are devoted to just this discussion; perhaps also to a short essay in the first volume of the 'Harvard Psychological Studies' (Macmillans), where he might find a large map with a tabular view of such classification. There is no doubt that it is more comfortable to 'repudiate' such 'extravagances' than to argue about them; but is it really more 'scientific'?

It is quite different with the very interesting letter from Professor Dewey of Chicago. His letter is full of important arguments worthy of serious consideration. He points clearly to certain dangers in the scheme, and the question is only whether those disadvantages ought not to be accepted in order to gain certain advantages which strongly outweigh them. Every one of the points he raises has been indeed matter for long discussion in the committees, and only after conscientious deliberation have we come to the decisions which he regrets.

As I tried to bring out in my *Atlantic Monthly* article, our real aim is to have a congress which has a definite task and which does not simply do the same kind of work that men of science are attempting every day and everywhere. We do not want, therefore, a bunch of disconnected congresses and in each one a bundle of disconnected papers which could just as well have appeared in the next number of the scientific magazines. We want to use this one great opportunity to work, in a time of scattered specialization, towards the unity of thought. We want to bring out the interrelations of all knowledge and to consider the fundamental principles which bind the sciences together. We want to create thus a holiday hour for science, with a purpose different from that of its workaday functions, an hour of reposeful self-reflection. Therefore, not everybody who would like to be heard could be admitted to the platform, but only those who are leaders in their field, and even these may not speak on their chance researches of the last week, but on definite subjects which all together form one systematic whole. Such a monumental work could be created only under the exceptional conditions of a congress embracing all sciences and all countries, and important enough to attract those who are masters in their work with a wide perspective. This was our aim and this alone our chief claim, as I tried to bring out in my essay, and I see with great satisfaction that Professor Dewey feels in full

harmony with this essential part of the undertaking.

The aspect which he dislikes is this: If we are to invite the leaders of all special sciences, each to consider the relations of his science to the other departments of knowledge, then we must clearly chop the one totality of knowledge into many special parts. That involves at once certain principles of division about which different opinions may exist. We have agreed to recognize 25 different departments with 134 sections, and such decision involves, of course, at once a certain grouping. The sections of the same department stand nearer together than the sections of different departments, and some of those departments again stand in close relations and thus form larger units. We grouped our 25 departments into 7 such chief divisions. Now Professor Dewey says we had no right to do all this, because our classification partly anticipates the work which is to be done by those who are to give the addresses. If each department has from the beginning a definite place on the program, its relations to all other sciences are determined beforehand and it has become superfluous to call in the scholars of the world simply to concur in the committee's ideas concerning the system of knowledge.

But I might ask, what else ought we to have done? I know very well that instead of the 134 sections, we might have been satisfied with half that number or might have indulged in double that number. But whatever number we might have agreed on, it would have remained open to the reproach that our decision was arbitrary, and yet we did not see a plan which allowed us to invite the speakers without defining beforehand the sectional field which each was to represent. A certain courage of opinion was then necessary and a certain adjustment to external conditions was unavoidable; in every case we consulted a large number of specialists. Quite similar is the question of classification. Just as we had to take the responsibility for the staking out of every section, we had also to decide in favor of a certain grouping if we desired to organize the congress and not simply to bring out a helter-skelter performance. Professor Dewey says: "The essential trait of the scientific life of to-day is its live-and-let-live character." I agree with that fully. In the regular work in our libraries and laboratories the year round everything depends upon this democratic freedom in which every one goes his own way, never asking what his neighbor is doing. It is that which has made the specialistic sciences of our day as strong as they are. But it has brought about at the same time this extreme tendency to disconnected specialization with its discouraging lack of unity; this heaping up of information without an ordered and harmonious view of the world; and if we are going to do what we aim at, if we want really to satisfy, at least once, the desire for unity, the longing for coordinations, then the hour has come in which we must not yield to this live-and-let-live tendency. It would mean to give up this ideal if we were to start at once without any principle of organization, ordering the sciences according to the alphabet, perhaps, instead of according to logic. The principles which are sufficient for a directory would undermine from the first the monument of scientific thought which we hope to see erected through the cooperation of the leaders of science. Therefore, some principle had to be accepted. And just as with number of sections, it may be said here too, that whatever principle could have been chosen would probably have had its defects and would certainly have been open to the criticism that it was a product of individual arbitrary decision.

A classification which in itself expresses all the practical relations in which sciences stand to each other is of course absolutely impossible. Professor Dewey's own science, psychology, has relations to philosophy, relations to physiology, and thus to medicine, relations to education and sociology, relations to history and language, relations to religion and law. A program which should try to arrange the place of psychology in the classified list in a way that psychology should become the neighbor of all these other sciences is unthinkable. On the other hand, only if we had tried to construct a scheme of such ex-

aggerated ambitions, should we have been really guilty of anticipating a part of that which our speakers are to tell us. We leave it to the invited scholar to discuss the totality of relations which practically must exist between psychology and other departments of knowledge. We confine ourselves to that minimum of classification which indicates the pure logical relation of the science in the sense of subordination and coordination, that minimum which every editor of an encyclopædic work would be asked to indicate without awakening suspicion of interference with the ideas of his contributors.

The only justified demand which could be made was that we choose a system of division and classification which should give fair play to every existing scientific tendency. And here alone came in the claim which I made for that scheme which has been accepted for the congress. I believed that our classification, more fully than any other, would leave room for every wholesome tendency of our times. I showed that a materialistic system would give fair opportunity to the natural sciences but not to the mental sciences; that a positivistic system would offer room for both mental and natural sciences; but that only an idealistic system has room for all; for the naturalistic and mental sciences, and also for those tendencies which are aiming at an interpretative as well as a descriptive account of civilization. And while we are trying to get, as I said, an organization with a minimum of classification, we were thus trying to provide at the same time for a maximum of freedom. Whatever other principles of classification we might have chosen would have led to an arbitrary suppression of some existing tendencies in modern thought. To use Professor Dewey's illustration: Those students of art, history, politics and education who treat them as systems of phenomena and those who treat them as systems of purposes, alike find in different sections their full opportunity. I have a slight impression that Professor Dewey would have preferred a classification which would have room only for one of the two groups. Our congress will be less partial than our critics. We shall have place and freedom for all.

But there is no reason to speak to-day, as I had to do in May, of a plan for the future. Our undertaking has already a little history. The program has been tried. Then was the moment for the appearance of those destructive effects which Professor Dewey feared. Professor Newcomb, Professor Small and I, who have been honored by the invitation to work as an organizing committee, have just returned from Europe, where we were to bring personal invitations to those who had been selected for the chief addresses. Professors Newcomb and Small visited France, England, Austria, Italy and Russia. I had to see the scholars of Germany and Switzerland. As the Germans have the reputation of being the most obstinate in their scientific ideas, their attitude towards the presented program may be considered as the severest test of it. I had to approach 98 scholars in Germany. Every one saw the full program with the ominous classification of science before he made his decision. Only one third of those whom I invited felt obliged to decline, and among them was not a single one who refused to come on account of the objections foreshadowed by Profesor Dewey. Some can not come because of ill health, some because of public engagements, some on account of the expense, and some because they are afraid of sea-sickness, but not a single one gave the slightest hint that he was disturbed by the limitations which the program might put on him. On the other hand, among those two thirds whom we hope to see here next September, very many expressed their deep sympathy with the plans and the program, and not a few insisted that it was just this which tempted them to risk the cumbersome voyage, while they would have disliked to participate in a routine congress without connected plan and program.

Of course that would not count for much in the minds of my critics, if those who have promised to come and deliver addresses under the conditions of our program were merely 'literary folk who indulge in such extravagances.' I may pick out some of the German

names. For human anatomy there comes Waldeyer of Berlin; for comparative anatomy, Fuerbringer of Heidelberg; for embryology, Hertwig of Berlin; for physiology, Engelmann of Berlin; for neurology, Erb of Heidelberg; for pathology, Marchand of Leipzig; for pathological anatomy, Orth of Berlin; for biology, Weismann of Freiburg; for botany, Goebel of Munich; for mineralogy, Zirkel of Leipzig; for geography, Gerland of Strassburg; for physical chemistry, Van't Hoff of Berlin; for physiological chemistry, Kossel of Heidelberg; for geophysics, Weichert of Göttingen; for mechanical engineering, Riedler of Berlin; for chemical technology, Witt of Berlin, and so on. Or to turn to the department of Professor Dewey: For history of philosophy, Windelband of Heidelberg; for logic, Riehl of Halle; for philosophy of nature, Ostwald of Leipzig; for methodology of science, Erdmann of Bonn; for æsthetics, Lipps of Munich; for psychology, Ebbinghaus of Breslau; for sociology, Toennies of Kiel; for social psychology, Simmel of Berlin; for ethnology, von den Steinen of Berlin; for pedagogy, Ziegler of Strassburg. Or to mention some other departments: Among the philologists I notice Brugman of Leipzig, Paul of Munich, Delitzsch of Berlin; Sievers of Leipzig, Kluge of Freiburg, Muncker of Munich; Oldenberg of Kiel and others. Among the economists, Schmoller of Berlin, Weber of Heidelberg, Stieda of Leipzig, Conrad of Halle, Sombart of Breslau, Wagner of Berlin. Among the jurists, Binding of Leipzig, Zorn of Bonn, Jellineck of Heidelberg, von Lizst of Berlin, Wach of Leipzig, von Bar of Göttingen, Kahl of Berlin, Zitelmann of Bonn, and so on. Among the theologians, Harnack of Berlin, Budde of Marburg, Pfleiderer of Berlin. For classical art, Furtwaengler of Munich; for modern art, Muther of Breslau; for mediæval history, Lamprecht of Leipzig. Enough of the enumeration. The list from England and from France is on the same level, and I anticipate that when we soon shall send out invitations to several hundred Americans for definite addresses, their response will not be less general, their list not less noble. But American participation is a question of the future. The list of acceptances which I have given here stands as a matter of fact beyond discussion. Is there really any doubt still possible that we have secured on the basis of that disastrous program the greatest combination of leaders of thought which has ever been brought together? When we three came home from our European mission after four months of hard labor to secure this result surpassing our own expectations, we might have felt justified in the hope that scientific men of this country would welcome us otherwise than with the cry that we, under the guise of science, have made science ridiculous.

HUGO MÜNSTERBERG.
HARVARD UNIVERSITY,
October 12, 1903.

SHORTER ARTICLES.

A PLEA FOR BETTER ENGLISH IN SCIENCE.

THAT to genuine scholarship is not always conjoined power of expression is common knowledge. Not a few men who have received academic training and have been honored with university degrees, who have explored profound mysteries of nature and discovered hidden laws, seem to be incapable of clearly explaining the processes they employ in their researches or of plainly setting forth their discoveries.

Not long ago a contributor to *The Critic* said:

> The development of scientific method is alleged to be one of the foremost characteristics of the present century. Philologists will ransack the earth, if not the heavens, for exact information as to date and authorship of even the fragments of ancient literature; botanists will tramp the forests for months to verify or disprove the rumor of a new orchid, and astronomers will go to any accessible point on the face of the globe for more exact figures on an eclipse or a transit of Venus. We might expect, then, to find a corresponding effort for exactness in the expression of thought, but an examination of the evidence is not altogether encouraging.

A few months ago a Boston editor published the following paragraph:

> The English language is suffering violence in many ways. Among those who are forgetting its

grace and beauty, the elements of its power, and the right use of it, are the students of pure and applied science, who, being eager in youth to get at their work directly, despise such mere scholastic accomplishments as rhetoric, grammar and logic. The result often is that, when they have discovered something which they are eager to give to the world and which the world ought to know, they have no vehicle of language and style worthy to convey their noble facts and great ideas to the public. * * * Many a scientific man has learned in middle life, with bitter regret, that he must take a lower place than he deserves among his fellow-workers because he can not tell what he knows in language that is intelligible and attractive. Others have been hindered in their course, and never knew the reason why.

But worse than inability to write vigorously and pleasingly is the widespread lack of appreciation of clear and precise expression. De Quincey, in his celebrated essay on 'Style,' said, referring especially to professional authors:

Proof lies before you, spread out upon every page, that no excess of awkwardness, or of inelegance, or of unrhythmical cadence, is so rated in the tariff of faults as to balance, in the writer's estimate, the trouble of remoulding a clause, of interpolating a phrase, or even of striking a pen through a superfluous word. The evidence is perpetual, not so much that they rest satisfied with their own random preconceptions of each clause or sentence, as that they never trouble themselves to form any such preconceptions. Whatever words tumble out under the blindest accidents of the moment, those are the words retained.

In his 'Principles of Success in Literature,' George Henry Lewes, referring to the writings of philosophers and men of science, said:

If you allude in their presence to the deplorably defective presentation of the ideas in some work distinguished for its learning, its profundity, or its novelty, it is probable that you will be despised as a frivolous setter up of manner over matter, a light-minded dilettante, unfitted for the simple austerities of science. But this is itself a light-minded contempt; a deeper insight would change the tone, and help to remove the disgraceful slovenliness and feebleness of composition which deface the majority of grave works, except those written by Frenchmen, who have been taught that composition is an art, and that no writer may neglect it.

If these strictures are just, the subject demands attention.

I am well acquainted with the writings, as found in manuscripts submitted for publication, of about one hundred scientists, young, middle-aged and old. One is justified in supposing that on such manuscripts the authors have done their best work. I have classified these authors in three groups: Good, fair, poor—'good' meaning those whose writing is clear, orderly and forcible; 'fair' meaning those whose writing is, indeed, clear and passably methodical, but is not forcible; and 'poor' meaning those whose writing is turbid or chaotic or has other defects which render it of little value, such as extreme verbosity. In the good group fall 19 per cent., in the fair group 57 per cent. and in the poor group 24 per cent. That is to say, neglecting such formal bagatelles as the split infinitive, and merging the details of purity, propriety and precision in the larger qualities, I find that fewer than one fifth of these authors write with clearness, method and force, and that almost one fourth of them do not write even clearly.

Into this evaluation there enters, of course, whatever weakness may reside in my individual judgment. I am sure, however, that the finding is not vitiated by prejudice or favoritism, conscious or unconscious; and in making the assignments to the three classes I gave every author the benefit of a doubt.

Of these men about 75 per cent. have had collegiate or university training; their almæ matres are our leading universities and schools of science. No fewer than twenty of them are now professors or instructors in such institutions of learning, and most of these fall in the fair class: their writing is not strong. In a few cases it is markedly weak; in other cases there is manifested an abundance of energy, but it is not under good control. In the good class there is at least one who is self-educated. Thus it appears that scientific and university life, with the

preparation in lower schools which this implies, does not insure good English.

If the results given seem somewhat depressing, let us take courage from the Frenchman who declared that 'it needs more delicate tact to be a great writer than a great thinker,' and inquire whether, after all, the condition presented is markedly exceptional.

It is probable that if any other large body of writers were similarly classified they would not make a much better showing. My evaluation, unlike that of the writers quoted, is of *manuscripts* as they are received from the authors. Literature of belletristic character, having little if any immediately practical or economic content, is necessarily dependent for existence upon its intrinsic merit and must be at least fair if it is accepted for publication. On the other hand, many abominably written scientific papers are so richly laden with the results of observation and experiment that they are given prompt publication—so prompt that they can receive but a modicum of editorial attention. That is to say, nearly everything written by men of science is published, whereas only the supposed cream of 'polite' productions is thus honored. If practically all that is written in the line of novels, of essays or of poetry were published, the 'poor' percentage would doubtless be higher than twenty-four.

Although, therefore, scientific writing, relatively considered, is not in a desperate plight, its condition is bad enough and is, I believe, susceptible of no little improvement. Recognizing that the able writer is born rather than made—that the chief requisites are, as Herbert Spencer has said, a sense of logical dependence, constructive ingenuity, a good verbal memory and a sensitive ear, and that these qualities are largely innate—I nevertheless believe that in many cases the ability is present but is never used; it lies dormant, and could be awakened and brought into service. What it needs is appreciation and utilization. "In England and Germany," says Lewes, "men who will spare no labor in research, grudge all labor in style; a morning is cheerfully devoted to verifying a quotation by one who will not spare ten minutes to reconstruct a clumsy sentence; a reference is sought with ardor, an appropriate expression in lieu of the inexact phrase which first suggests itself does not seem worth seeking. What are we to say to a man who spends a quarter's income on a diamond pin which he sticks in a greasy cravat?" One can hardly escape the conviction that this criticism applies to America as well as to England and Germany.

It is true that, according to the figures, a large majority write clearly, but clearness alone is not sufficient. Sentences and paragraphs may themselves be perfectly clear, but the ideas they clothe be so inconsequent if not inconsequential, that their total effect on the reader is weariness. Effective composition implies sequence and unity, symmetry and proportion. Vital writing, whether it be a sentence, a paragraph or a disquisition, is characterized by structure and integrity. Such are the famous paragraphs of Macaulay, whose 'astonishing power of arranging facts and bringing them to bear on any subject * * * joined with a clear and vigorous style,' says McMaster, 'enabled him to produce historical scenes with a grouping, a finish and a splendor to which no other writer can approach'; such are the exquisite essays of Lowell, who 'added to the love of learning the love of expression'; and such are the philosophical dissertations of Herbert Spencer, whose power of presentation is remarkable. Schopenhauer classified authors into three kinds: "First," said he, "come those who write without thinking. They write from a full memory, from reminiscences. This class is the most numerous. Then come those who do their thinking while they are writing, and there is no lack of them. Last of all come those writers who think before they begin to write; they are rare." If Addison's definition of good writing (a definition which was warmly endorsed by Hume)—that it consists in the expression of sentiments or ideas which are natural but not obvious—is valid, it is apparent why the productions of authors who fall in the first class are poor: the lucid statement of relations which are not obvious

requires thought. Papers by writers of this class are inevitably amorphous and weak. If those by the second class do exhibit power, the power is apt to be lawless, and the tectonics are likely to be distractingly apparent to the reader. Only papers by the third class can possess structure and grace. Schopenhauer declares further that an author's style is an exact expression of his mode of thought; that it shows the formal nature—which must always remain the same—of all the thoughts of a man; and, therefore, that when he has read a few pages of an author, whatever the subject, he knows about how far that author can help him. Similarly wrote Dean Alford in his 'Plea for the Queen's English': "If the way in which men express their thoughts is slipshod and mean, it will be very difficult for their thoughts themselves to escape being the same."

Again, effective composition implies concentration, distillation, a process akin to chemical rectification; and this it is that energizes. Josh Billings said: "I don't care how much a man talks if he only says it in a few words." Lecky calls this power the supreme literary gift of condensation, which Gibbon possessed in so high degree. In the case of a talented writer this process is subconscious and rapid, but others achieve the result through conscious effort if not downright labor. Macaulay made almost endless changes, both of matter and of style. Said Joubert: "If there is a man tormented by the accursed ambition to put a whole book into a page, a whole page into a phrase, and that phrase into a word, it is I." Little wonder that Joubert has succeeded La Rochefoucauld as the most famous coiner of aphorisms. John Burroughs has lately said, in his 'Literary Values': "There is a sort of mechanical equivalent between the force expended in compacting a sentence and the force or stimulus it imparts to the reader's mind. * * * So much writing there is that is like half-live coals buried in ashes—dead verbiage." Spencer, in his essay on 'The Philosophy of Style,' observes that the strongest effects are produced by interjections, which condense entire sentences into syllables, and that signs are still more forcible. For instance, to say 'Leave the room' is less expressive than to point to the door. Doubtless science would make slow progress if obliged to use the sign language; yet in the prolixity and tenuity which characterize much of the scientific writing of the day there is no progress, but only vexation of the spirit of the reader. "It is with words as with sunbeams," says Saxe, "the more they are condensed the deeper they burn." In sententiousness there is strength. We feel it in the epigrammatic sentences of Emerson, who wrote to Carlyle of 'paragraphs incompressible,' and most of whose titles are single words. On the other hand, some of Kant's sentences have been measured by a carpenter and been found to run two feet eight by six inches. "A sentence with that enormous span," says De Quincey, "is fit only for the use of a megatherium."

As an example of scientific writing which is not only clear and methodical, but forcible, I may mention that of the late George H. Williams, in whose untimely death the scientific world suffered a loss.

That clearness and force are desiderata in scientific writing will be admitted by all. It may be somewhat rash, however, even to mention in such connection a higher quality; but I observe that into this article the words 'grace' and 'beauty' have already crept and I am not disposed to cancel them. Says Joubert: "In the mind of certain writers nothing is grouped or draped or modeled; their pages offer only a flat surface on which words roll." Says Lewes: "A man must have the art of expression or he will remain obscure." Says Buffon: "Only well-written works will survive; abundance of knowledge and singularity of facts are not a guaranty of immortality."

Rhetoric, we know, was to Huxley an abomination—a vile cosmetic; yet it is not difficult to discover in Huxley's writings pages that are rhetorically elegant. The fact that with him the action was spontaneous is merely evidence of his artistic endowment; and there can be no doubt that his shafts were hurled at the foolishness of literary foppery, not at

that natural grace of style which, like elegance of manners, can be felt but not analyzed. Doubtless the technical description of a dinosaur or of an aboriginal shell-heap can derive little aid from metonymy or climax; but the field of the scientific specialist merges insensibly in common ground, and when he is on the borders he is within view of the whole world of letters. Moreover, the man of science often takes literary excursions into neighboring provinces—at least many of the great men of science do. Witness Huxley himself, with his 'Lay Sermons'; and John Tyndall, who almost made a specialty of feeding 'Fragments' to the unscientific, and whose fame is due chiefly to his brilliant advocacy, oral and in writing, of physical science; and Ernst Haeckel, with his 'Riddle of the Universe.'

"The importance of style," says Lewes, "is generally unsuspected by philosophers and men of science, who are quite aware of its advantage in all departments of *belles lettres.* * * * Had there been a clear understanding of style as the living body of thought, and not its 'dress' * * * the error I am noticing would not have spread so widely. The matter is confluent with the manner, and only through the style can thought reach the reader's mind." Here Lewes but repeats De Quincey, who cites Wordsworth to the effect that it is the highest degree unphilosophical to call language or diction 'the dress of thought'; Wordsworth would call it the *incarnation* of thought. 'Never in one word,' says De Quincey, 'was so profound a truth conveyed.'

Of the authors whose writings I have classified as 'good,' there are five or six whose writings I should place in the highest class, that of excellent; for to the characteristics of clearness, orderliness and forcibleness they add the final quality of elegance or attractiveness. As an example of scientific writing of this class, mention may be made of that of the late Dr. John S. Newberry. If one doubts it one should read his paper on 'The Ancient Lakes of Western North America,' in the Fourth Hayden Annual.

Scientific men, especially the young men, are prone to spend most of their time in observing and experimenting; comparatively little is devoted to studying the accumulated data and their relations, and little indeed is reserved for composition. Phenomena are sought with eagerness, but, once discovered, interest in them wanes. The field and the laboratory are too alluring to be resisted for long, and the time to be devoted to reflection and to writing is minimized. Neglecting what Coleridge termed 'ratiocinative meditation,' they produce with facility papers consisting of crude raw materials which can but repel persons endowed with a sense of order, strength and beauty. Doubtless these writers are, as Henry James says, 'strangers to the pangs and the weariness that accompany the sense of exactitude, of proportion and of beauty,' but in many cases it is also true that they are writers who 'have been hindered in their course and never knew the reason why.' I appeal to the scientific men of America, especially the younger men, to cast off this shameful indifference to the power and beauty of their marvelously rich and adaptable language, and to devote to their writing some of the energy they manifest in the field and some of the patience they exercise in the laboratory.

In a recently issued university catalogue, under the heading 'Admission' and the subheading 'English,' appears the following item of gratifying information: "The candidate should read all the prescribed books, but knowledge of them will be regarded as less important than ability to write English." That a young man entering on a scientific course at a university should have read carefully 'Silas Marner' and 'The Sir Roger de Coverley Papers' is doubtless desirable, but that he should be able to express, in English that is at least clear and vigorous, whatever he may know on any subject is of far more importance. Without the property of reversibility, giving the motor, the dynamo-electric machine would lack the greater portion of its usefulness. Though a man be surcharged with knowledge, his usefulness to mankind must be slight unless he is able to

impart the knowledge through the medium of clear and forcible language; and there are indications that both the preparatory schools and the universities are awaking to a realization of this fact.

P. C. Warman.

A CONTRIBUTION TO THE CRANIOLOGY OF THE PEOPLE OF SCOTLAND.*

Under this title Professor Sir William Turner, than whom no one is better qualified to deal with this subject, presents the first systematic account of the cranial characters of the people of Scotland. The study is based on 176 carefully gathered skulls (117 males and 59 females) obtained principally in the counties south of the Clyde and Tay ('lowland Scotland').

The memoir is written in the same clear style, eminently fit for instruction, which marks all the works of this author, and the results of the study are of much interest. These results are briefly summarized as follows:

"The Scottish cranium is large and capacious; the vertex is seldom heeled or roof-like, but has a low rounded arch in the vertical transverse plane at and behind the bregma." The side walls "bulge slightly outwards in the parieto-squamous region, so that the greatest breadth is usually at or near the squamous suture. The occipital squama bulges behind the inion." The glabella and supraorbital ridges, in men, 'are fairly but not strongly pronounced, the forehead only slightly recedes from the vertical plane and the nasion is scarcely depressed.'

From the "analysis of the cephalic indices, it would appear that a brachycephalic type of skull prevailed in Fife, in the Lothians, in the northeast counties of Forfar, Kincardine and Banff; and it occurred to some extent in Shetland, in Ayr, in the border county of Peebles, and in Stirlingshire."

"The dolichocephalic type of skull was feebly represented in Fife; it was proportionally more numerous in the Lothians; it was represented in Lanark, Ayr, Shetland and the Hebrides. It formed the prevailing type in Wigtonshire, in Caithness, in the skulls from the Highland counties, and in the important series of skulls from Renfrewshire."

The vertical diameter—basion-bregma—(mean, in males, 132.4 mm.), was only in two out of 150 of the Scottish crania in which the measurement would be taken in excess of the breadth; the two measurements were equal in four others, while 'in all the rest, whether cephalic index was high or low, the vertical diameter was less than the breadth.' 'The Scottish skulls are platychamæcephalic.'

Among the 73 male and 42 female crania that were cubed (with shot, according to Turner's method), 'the maximum capacity in the male skulls was 1,855 c.c., the minimum was 1,230 c.c., and the mean was 1,478 c.c.'; 'the maximum in the female was 1,625 c.c., the minimum 1,100 c.c. and the mean 1,322 c.c.' Apparently the Scottish male skull is 'somewhat in excess of the mean ascribed to the crania of European men.' The female skull, similarly as in other races and people, is about ten per cent. less capacious than the male.' 'In twenty-five male dolichocephalic crania the mean capacity was 1,516 c.c.'; in twenty-one male crania of cephalic index 'from 75 to 77.4, the mean capacity was 1,519 c.c.'; in fifteen with cephalic index of '77.5 to 79.9, the mean capacity was 1,452 c.c.'; and 'in thirteen brachycephalic skulls the mean capacity was 1,469 c.c.' The Scottish skulls 'with dolichocephalic proportions had a distinctly greater mean capacity than the brachycephalic.'

The highest mean cranial capacity was given in the males, 'by the skulls from Fife, Mid-Lothian, Shetland and Renfrewshire'; while the mean was lowest in the skulls 'from Edinburgh and Leith, West Lothian, the northeastern counties, the highland counties and the dissecting-room.'

"The face was usually orthognathous, sometimes mesognathous; the nose was prominent, long and narrow, leptorhine; the orbits had usually the vertical diameter high in relation to the transverse, mesoseme or megaseme; the

* *Trans. Roy. Soc. Edinburgh*, Vol. XL., Part III., No. 24, 1903.

face was high in relation to the width, leptoprosopic." "The lower jaw had a well-defined angle, the body of the bone was massive in the males, and with a pronounced chin."

So much for this first memoir, which leaves to be desired only greater numbers of specimens from some of the counties and, especially with the relation to cranial capacity, estimates of height of the individuals. A second memoir, to contain an account of prehistoric Scottish skulls, as well as 'a discussion of the character of Scottish crania and heads in their general ethnographical relation to prehistoric races in Britain, and to the people of the adjoining part of the continent of Europe' is to follow.

A. HRDLICKA.

U. S. NATIONAL MUSEUM,
WASHINGTON, D. C.

VERTEBRATE PALEONTOLOGY AT THE CARNEGIE MUSEUM.

THROUGH the continued generosity of Mr. Carnegie the usual activity has been maintained during the past year in the Department of Vertebrate Paleontology at this museum.

The Bayet Collection of Fossils.—Negotiations begun more than a year ago by the present writer resulted in July in the acquisition of the paleontological collections of Baron de Bayet of Brussels, Belgium. This collection is especially rich in Mesozoic vertebrates from Solenhofen, Cerin, Holzmaden, Lyme Regis and the province of Benevento, Italy; in Tertiary fishes and other vertebrates, invertebrates and plants from the famous locality of Monte Bolca, near Verona, Italy; from Armissan, near Narbonne, France; from the Belgian Tertiaries; from Sicily, etc. It also contains large and valuable collections of insects and other invertebrates from the Solenhofen beds of Bavaria, a superb collection of European cephalopoda from the Mesozoic and of Paleozoic trilobites and other invertebrates.

Though containing no types and little that is new to paleontology, its acquisition by an American museum is of importance as making accessible for the first time to American students any considerable collection of European vertebrates without the necessity of a trip to Europe. Dr. C. R. Eastman has undertaken to prepare a memoir descriptive of the fishes in the collection, and it is the desire of the curator of the department to arrange for the treatment of the other groups in a similar manner by equally competent specialists, so that the material in the collection may be made known and available for purposes of comparison to students of paleontology.

It will doubtless be many years before a similar opportunity will present itself for acquiring at a single stroke so large and varied a collection of European fossil vertebrates, and American paleontologists are indebted to Mr. Carnegie for his generosity in supplying the funds necessary for the purchase of this valuable collection.

Field Work during the Season of 1903.—During the season just drawing to a close four parties have been engaged, under the general direction of the curator, in studying the geology and in collecting vertebrate and other fossils from various Tertiary, Mesozoic and other horizons of the west, chiefly in Kansas, Wyoming and Montana.

Pursuant to a general plan undertaken some time since, Mr. Earl Douglass has continued his explorations of the Tertiary lake basins of western Montana and has been successful in securing considerable collections representative of the fossil faunas and floras of those deposits. Of greatest importance among the results of his labors in that region may be mentioned the discovery of Oligocene beds referable to the White River and containing the remains of a rich and varied vertebrate fauna in a good state of preservation. Heretofore the White River formations of that region have yielded comparatively few and for the most part poorly preserved vertebrates. In addition to his work in the Tertiary Mr. Douglass was also able to make some interesting collections from, and observations relating to the Carboniferous and Permian(?) of that region.

During the earlier part of the season Mr. C. W. Gilmore was engaged in completing the

work in a Jurassic dinosaur quarry opened by him during the preceding season at the base of the Freezeout Mountains in southern Wyoming. After successfully completing this work he began, early in June, explorations in the chalk (Niobrara) of western Kansas, where he was joined by Dr. E. H. Sellards as assistant. It is the earnest desire of the curator of this department that the paleontological collections of the museum shall eventually represent in a creditable manner the faunas of all the more important fossil-bearing horizons of our own country at least. It was with the idea of acquiring such a representative collection of Niobrara fossils that the work in Kansas by Mr. Gilmore and Dr. Sellards was undertaken. Already some forty-five boxes of material have been collected and we hope to continue the work in this formation for some years.

Mr. W. H. Utterback completed the unearthing of the splendid skeleton of *Diplodocus*, discovered by him the preceding year in the Jurassic deposits on the Red Fork of Powder River at the foot of the Big Horn Mountains in central Wyoming. In this same region he also secured considerable portions of the skeletons of two other colossal Jurassic dinosaurs. In the latter part of August Mr. Utterback was transferred to central Montana to continue the work in the Cretaceous of that region carried on during the month of August by the present writer. In this field considerable new and interesting material has been discovered, coming chiefly from the Judith River beds.

Research Work.—In research, beside several shorter papers by the curator, Mr. Douglass and Mr. Gilmore, there have appeared or are now in press an important paper by Mr. Douglass on the vertebrate fauna of the Tertiary lake beds of Montana (*Annals Carnegie Museum*, Vol. 2, pp. 145–199 with Plate and 37 figures in the text); a paper by the present writer on the 'Oligocene Canidæ' (*Memoirs Carnegie Museum*, Vol. I., No. II., pp. 65–108, 6 plates and 7 figures in text) and another by the same author on the 'Osteology of *Haplocanthosaurus*' (*Memoirs Carnegie Museum*, Vol. II., No. I., pp. 1–75, 6 plates and 30 figures in text).

The most important additions to the exhibition series during the year have been the skeleton of *Daphœnus felinus* mounted by Mr. A. S. Coggeshall and the skeletons of a Loup Fork camel and of an Oligocene sabre-toothed cat (*Hoplophoneus*) mounted by Mr. O. A. Paterson. Two splendid skeletons of *Ichthyosaurus* have also been placed on exhibition.

Considerable progress has also been made in the preparation of casts of the skeleton of *Diplodocus carnegii* for exchange with other museums.

J. B. Hatcher,
Curator Vertebrate Paleontology.
Carnegie Museum,
October 6, 1903.

ETHNOLOGICAL AND ARCHEOLOGICAL SURVEY OF CALIFORNIA.

For several years the University of California, through its Department of Anthropology and by the liberal assistance of Mrs. Phoebe A. Hearst, has been engaged in an Ethnological and Archeological Survey of the State. A large amount of material, illustrative of Indian life and culture in past and present times, has been obtained and will form an important part of the anthropological collections which will in the future be exhibited in a museum of the university at Berkeley. At the present time this collection, with others of the department, is temporarily placed in one of the buildings of the affiliated colleges belonging to the University in San Francisco. Here the large and valuable collections are safely cared for until the permanent museum building is secured.

Systematic explorations are being made of the later gravel deposits, of several caves, and of the ancient shellheaps, in order to ascertain when man first occupied this region. The languages of the existing Indians are being studied by experts of the department; the customs and mythology of the different tribes are being carefully recorded; and collections illustrating their arts are being formed for the museum. A study of the physical characters of the various groups of Indians, combined

with that of the skeletons found during the archeological explorations, is being made in order to determine the physical relations of the Indians of California with those of other regions. By correlating the physical characters, the particular cultures of the past and present Indians, and the various linguistic stocks or families still extant, it is hoped to solve the great problem of the relationship of the numerous groups of Indians in California, and their relationship with peoples of other parts of the continent and possibly with certain tribes of Asia.

Nowhere in America has there been such a diversity of Indian languages as in California, a condition which has long puzzled anthropologists. During the past five years more investigations of these languages have been made by the University and by eastern institutions than in all previous time. These Indian languages are now fast disappearing. Several are at the present moment known only by five or six, others by twenty or thirty individuals, and hardly a year passes without some special dialect, or even language, becoming extinct. For this reason it is desired that students should be instructed in the methods of recording and studying Indian languages, and then devote themselves to special research. The University is, therefore, giving instruction in this branch of linguistics with the hope of preparing students to carry on the research before the opportunities pass away. Similar reasons apply to researches in other divisions of ethnology, and in archeology; hence the training of students in these subjects is also undertaken by the Department of Anthropology.

The officers of the department make a special appeal to persons in all parts of the State and adjacent regions for aid in this survey. Hundreds of Indian objects are found annually, which if carefully labelled as to where and how found and sent to the university, would, when brought together for comparative study, aid in the settlement of many important questions. The distribution of a particular kind of stone implement or of an ancient form of basket, and of many other objects of Indian manufacture (even the peculiar stone of which an implement is made is of great importance), will aid in determining the distribution of a tribe or group of which other records may be lost or so uncertain that just such confirmatory evidence to establish a particular point is required.

Information relating to the location of caves, shellheaps, old burial places, ancient village sites, and scattered fragments or survivors of nearly extinct tribes, is earnestly solicited, that such may be investigated by the department and may be correctly recorded on its ethnological and archeological maps of the State.

The university is by this survey carrying on a research of great importance in obtaining a knowledge of the first peopling of the Pacific Coast and of the early migrations, and of the relationships of the recent and present Indians, a research that is required by anthropologists and by all interested in the early history of man. This work has been well begun, but assistance of many kinds is needed for its progress. This assistance it is hoped will be given to aid the University of the State in an undertaking of such general interest.

Two volumes of the publications of the department, relating to the languages, myths and customs of certain tribes of California, are now in press and are to be followed by others as the material is prepared.

Correspondence leading to aid in this survey is solicited by the Department of Anthropology of the University of California.

BENJ. IDE WHEELER,
President of the University.
F. W. PUTNAM,
Director of the Department of Anthropology.
BERKELEY, CALIFORNIA,
October 15, 1903.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR RAPHAEL PUMPELLY, of Newport, R. I., has recently returned from a summer's journey in Turkestan, where he made a reconnaissance under the auspices of the Carnegie Institution of the ancient human occupation of the region in relation to its physiography. The other members of the expedition were Professor W. M. Davis, of Harvard; Mr.

Ellsworth Huntington, Carnegie research assistant, and Mr. R. W. Pumpelly, with Mr. S. de Brovtzine of St. Petersburg as interpreter. Mr. Richard Norton, director of the American School of Classical Studies in Rome, was an independent member of the party. From Baku, the great petroleum port on the west coast of the Caspian, the travelers crossed by steamer to Krasnovodsk May 23, whence the Central Asiatic railway carried them, with many stops and side excursions on the way, to the end of the main line at Tashkent and to the end of a branch line at Andizhan June 26. Professor Pumpelly, with Messrs. Norton and Pumpelly, then made an excursion southeastward across the Alai range and valley to Lake Karakul on the northern Pamir, returning *via* Andizhan, Baku and Constantinople, and reaching America on September 4. Professor Davis and Mr. Huntington went northeast, crossing the western Tian Shan ranges to Lake Issikul, where they separated; Professor Davis turned northward and came home *via* Semipalatirsk, Omsk and St. Peterburg; Mr. Huntington went south to Kashgar and west to Samarkand and Aschabad, where he has lately arrived and where he will make his winter headquarters after an excursion into northern Persia.

The Research Laboratory of Physical Chemistry at the Massachusetts Institute of Technology, the establishment of which was announced in Science for June 5, 1903, was opened on September 20 with a staff of eight research associates and assistants and two graduate scholars working under the direction of Professors A. A. Noyes, H. M. Goodwin and W. R. Whitney. The following investigations are already in progress: 'The Electrical Conductivity of Aqueous Solutions at High Temperatures (up to 306° and higher),' three separate researches carried on by Dr. W. D. Coolidge, Dr. H. C. Cooper and Mr. A. C. Melcher; 'The Conductivity of Fused Salts,' by Mr. R. Haskell; 'Electrical Transference Determinations with Nitric Acid,' by Mr. Y. Kato; 'The Migration and Coagulation of Colloids,' by Dr. J. C. Blake; 'The Equilibrium in Solution between Milk Sugar and Its Hydrate,' by Mr. C. S. Hudson; 'The Dissociation-Relations of Sulphuric Acid at Various Temperatures,' by Mr. M. A. Stewart; 'The Hydrolysis of Ammonium Sulphide determined by Vapor Pressure Measurements,' by Mr. C. F. Sammet. The researches upon the conductivity of aqueous solutions and upon transference are assisted by grants made to Professor Noyes by the Carnegie Institution. Besides these physico-chemical investigations, work is being continued with the assistance of Mr. C. S. Bryan in developing a new system of qualitative analysis which shall include nearly all the rare metallic elements.

At the ceremonies attending the installation of the Rev. Dr. Gordon as principal of Queen's University, Kingston, Ont., the degree of LL.D. was conferred, among others upon Dr. J. E. Creighton, professor of philosophy at Cornell University, and Dr. Victor Goldschmidt, professor of mineralogy, Heidelberg University, Germany.

The Harvard correspondent of the *Evening Post* states that the Hon. William H. Moody, secretary of the Navy, and Mr. Gifford Pinchot, chief of the Bureau of Forestry, will speak at a meeting of the members of Harvard University on November 2, under the auspices of the Political Club, a non-partisan organization of students organized to promote interest and active participation in politics on the part of university men. Secretary Moody's subject will be 'The Administration of the Navy,' and Mr. Pinchot's 'The Opportunities in the Government Scientific Departments.'

Dr. Edgar J. Banks has been given charge of the archeological excavations to be undertaken near Bysmias by the University of Chicago with the permission of the Turkish government.

P. G. Nutting, A.B. (Stanford), Ph.D. (Cornell), has been appointed to a position in the National Bureau of Standards.

Dr. L. Messerschmidt has been appointed assistant to the director of the Royal Museum in Berlin.

A COURSE of lectures on tropical medicine will be given at the Jefferson Medical College by Capt. Charles F. Kieffer, assistant surgeon, U. S. Army. The lectures will be given at 4 P.M. each Monday in the amphitheater of the hospital.

ACCORDING to a cablegram to the daily papers, Mr. L. A. Fischer, of the National Bureau of Standards, has compared the American meter with the international standard and has found it accurate. Mr. Fischer is investigating the systems of weights and measures of European countries with the view of drawing up a report upon which Secretary Cortelyou, of the Department of Commerce and Labor, will make recommendations to Congress.

THE Stockholm correspondent of the London *Morning Advertiser* says that the Academy of Science proposes to confer the Nobel prize for physics on Mr. William Marconi.

A MONUMENT is to be erected at Brussels as a memorial to Zenobe Gramme, known for his work in electricity. M. Léon Janssen is chairman of the committee in charge.

AN obelisk of unpolished grey granite has been placed over Virchow's grave in the old Matthäi graveyard, Berlin. It bears on one side a black marble tablet, on which is inscribed 'Rudolph Virchow,' and the date of his birth and death. A statue of Virchow will also be erected near the place where his scientific work was conducted.

PROFESSOR ALEXANDER ROLLETT, of Graz, known for his researches in the physiology of blood and muscles, died on October 1, in his seventieth year. The death is also announced of M. G. R. Dahlander, professor in the Polytechnic Institute at Stockholm.

THE *Bulletin of the American Mathematical Society* states that the Carnegie Institution has in preparation, under charge of the librarian of Congress, a handbook of learned societies and institutions, which is to contain various information of importance to scholars, but not hitherto published in convenient form.

THE Marconi system of wireless telegraphy has been put in operation between Peking and the coast.

IT is said that Dr. August Greth of San Francisco, who had put his small savings into an airship of crude construction, sailed about over that city on October 18, apparently having full control of his machine. While sailing to the Presido his power, furnished by a six horsepower gasoline engine, failed him, and he descended into the water of the bay. Money has now been offered him to build a better machine.

THE third annual intercollegiate geological excursion in New England was held at Meriden, Conn., on Saturday, October 17, under the guidance of Professor Gregory of Yale University. The geological profit of the excursion was unfortunately interfered with by fog on West Peak of the Hanging Hills, and by several heavy showers in the valley; nevertheless the general structure of the region was pointed out, the double lava flow in the Meriden quarry was well seen and several of the faults by which the district is divided into long, narrow blocks were demonstrated. The largest delegations of students were from Yale University, under Professors Gregory, Pirsson and Barrell, and from Wesleyan University under Professor Rice. Harvard, Wellesley, Amherst, Smith and Williams were also represented, as well as a number of secondary schools. Over one hundred persons took part in the excursion.

THE *Zoological Society Bulletin* states that the end of the next twelve months will reveal an important advance in the development of the New York Zoological Park. The Antelope House and its twenty-two yards outside will be ready for use about November 1. The building of an Ostrich and Cassowary House, 170 feet long, has been begun and also the erection of a Small Mammals' House, 170 feet long. A contract for the large Bird House was awarded on September 14. Plans for a large Deer House are now in course of preparation. The Llama House is ready for use and the entire collection of animals arrived about October 1 as the gift of Mr. Robert S. Brewster. The visitors to the Park during the month of August numbered 155,000, an increase of 29,000 over the records of

the previous year. The largest attendance so far was on Sunday, September 16, amounting to 35,667 persons.

The director-in-chief and other members of the staff of the New York Botanical Garden will be pleased to receive members and their friends at the grounds in Bronx Park on every Saturday in October and November. Train leaves Grand Central Station, Harlem Division, N. Y. C. R. R., at 2:35 P.M., for Bronx Park. Returning train leaves Bronx Park at 5:32 P.M. Opportunity will be given for inspection of the museums, laboratories, library and herbarium, the large conservatories, the herbaceous collection, the hemlock forest and parts of the arboretum site. The walk planned will be a little over a mile. Lectures will be given in the museum building at 4:30 o'clock, as follows:

October 3, 'The Botanical Exploration of the West Indies,' by Dr. N. L. Britton.

October 10, 'Some Aspects of Tropical Agriculture,' by Professor F. S. Earle.

October 17, 'Some Features of Jamaican Vegetation,' by Professor L. M. Underwood.

October 24, 'Features of the Land and Marine Flora of Porto Rico,' by Dr. M. A. Howe.

October 31, 'Explorations in Hayti, the Negro Republic,' by Mr. G. V. Nash.

November 7, 'Mountains and Forests of Dominica,' by Professor F. E. Lloyd.

November 14, 'Beverages of Vegetable Origin,' by Professor H. H. Rusby.

Among the lectures to be given this season before the Royal Institution, London, are the following:

'The Present Position of English Commerce,' by Lord Avebury, F.R.S.

'The Work and Aims of the London University,' by Sir Arthur W. Rücker, F.R.S.

'The Brains and Minds of Animals,' by Alex. Hill, Esq.

'Persia and the Persian Gulf,' by J. D. Rees, Esq.

'Radium and the Periodic Law in connection with Recently Discovered Elements,' by Sir William Ramsay, F.R.S.

'Volcanoes, with special reference to the recent eruptions,' by Professor E. J. Garwood.

'Balloons and Flying Machines,' by J. M. Bacon, Esq.

'The Ice-Breaker *Ermack*,' by Arthur Gulston, Esq.

"Mars and its 'Canals,'" by E. Walter Maunder, Esq.

'1. Ice, 2. Water, 3. Steam,' by Dr. William Hampson, M.A.

'Mexico and its Natural History,' H. F. Gadow, Esq. F.R.S.

'The Food of the People,' by Robert Hutchinson, Esq.

'The Crustacean Question,' by Professor G. B. Howes, F.R.S.

'The Measurement of the Heavens,' by J. D. McClure, Esq.

According to the latest bulletin of the Health Department of Chicago, the remarkable decrease in the mortality of children less than one year old that has taken place since 1891—a decrease of 60.1 per cent.—is due not so much to an improved milk supply, the antitoxin treatment of diphtheria and other causes often cited to account for it, as to the work of woman's clubs and similar organizations in the education of mothers in the hygiene of the young. This, it is believed, is the principal factor in giving the baby a better chance for life.

The New York *Times* states that the board recently organized to consider and report upon the subject of engineering instruction and training for officers of the line of the navy, of which Captain George A. Converse is the senior member, recently held its first session in New York. The recommendations contained in the order convening the board were talked over, and, while no definite outline was determined upon, it was concluded that the subject is one of large scope, which will require careful study and preparation. Undoubtedly there will be established an engineering school for officers, and this may, perhaps, be located at the Naval Academy at Annapolis, using the engineering experimental station recently established at that place. Congress at its last session created this experimental station upon the recommendation of Rear Admiral George W. Melville, head of the Bureau of Steam Engineering of the Navy Department, who advocated the idea for several years before his efforts were successful. The board expects that it will take at least six months for it to prepare and outline a proper course of

instruction for the new school. The board has decided to hold its sessions in Washington hereafter.

DR. FREDERICK ROSE, British consul in Stuttgart, has lately prepared a series of reports on technical education of various kinds in Germany, which have been issued from time to time by the Foreign Office. The latest of these deals with instruction in forestry and the present condition of forest economy. According to the abstract in the London *Times*, he describes the preliminary educational and other qualifications demanded from students, and then proceeds to explain the organization and course of instruction at Eberswalde, in Prussia, Aschaffenburg, in Bavaria and Karlsruhe, in Baden, as well as the subsequent prospects of the qualified students in the different states, in order to show what forestry as a profession is in Germany. He then takes the kingdom of Würtemberg as an example of the economical benefits of the scientific management of forests, and from this estimates the annual value of the forest products of the Empire. Some of his statements on this subject will be of interest. Out of the total of 135 million acres forming the German Empire, about 35 million consist of forests or forest lands. Rather more than half of this consists of purely forest holdings, the remainder being attached to agricultural holdings. Baden has the largest relative area of forests; the proportion of the whole area of the State being 40 per cent., while in Prussia it is 25, in Bavaria 33 and in Würtemberg 30 per cent. The oak is chiefly grown on the Lower Rhine and in Westphalia, the beech in Pomerania, the fir in South Germany, the pine on the Central German hills, the Scotch pine on the plains of northeastern Germany, while the low-lying lands everywhere grow the elm, ash, beech, oak and birch. The Scotch pine is the most widely cultivated of any tree, the pine and fir and the beech coming next in extent of area covered. The annual revenue derived from forests in Germany is estimated at 15 to 18 millions sterling; in regard to Würtemberg the precise figures are known. This state possesses 1½ millions of acres of forests, the produce of which in 1900 yielded £1,700,000; the cost of production was £500,000, leaving a profit of £1,200,000, or about 16s. an acre. If the taxation be deduced from this, there is a clear profit of 14s. an acre. Statistics given by Dr. Rose show a steady annual increase in the value per acre of forest produce since 1860, which amounts in the cases of Prussia, Saxony and Würtemberg to as much as 80 per cent. The report concludes with some interesting observations on the importance to a nation from various points of view—sentimental, esthetic and hygienic, as well as economical—of its forests.

THE Royal Society of New South Wales held a conversazione on August 27. The exhibits included the following: Mr. R. T. Baker, exhibits from Technological Museum; Mr. Henry Deane, models of the new Central Railway station: clock tower, smaller tower, arrival bridge, general view; His Honor Judge Docker, stereoscope and set of stereographs of Tasmanian scenery; Geological Survey, N. S. Wales, framed photographs of N. S. Wales geology, meteorite and casts from Gilgoin Station, N. S. Wales, miscellaneous minerals; Mr. W. M. Hamlet, microscope showing metallic structure by etching methods now used in metalloscope, microscopes; Mr. H. L. Jones, Clark automatic telephone switchboard, model of modern bogey frame with wheels, used on heavy railway tracks in the United States; Mr. J. H. Maiden, copies of plans of the botanic gardens and government domains from 1807 to 1880; Mr. Ernest W. Warren, physical apparatus—vacuum tubes, X-Rays, high frequency apparatus, induction coils, etc.

DR. F. HENROTIN writes to the *Journal of the American Medical Association* that Rush Medical College, Chicago, has established a museum in which will be preserved and exhibited permanently objects of interest and value in the history of medicine. Especial attention will be given obsolete instruments and appliances for the diagnosis and treatment of disease. Many physicians and others have instruments that perhaps even a short time ago were in use, but which have been

laid away for more recent inventions; these are of historical value. Medicine in the United States has so brief a history that it should not be difficult to represent in this museum its complete development in the instruments and appliances that have come and gone, that have been of great value, but have given place to better inventions as the art has progressed. The late Professor Fenger bequeathed his own instruments to this museum, and it was the wish of this thoughtful man that his gift should be but the foundation for a collection that would show the development of the art he loved and for which he did so much. Rush Medical College has set aside a commodious room in the newly-opened Senn Hall for the permanent use of this museum. Gifts will be inscribed with the name of the donor and any remarks as to their history, original owner, user, etc., that may increase their interest. All other objects that have any interesting relation to the history of medicine or to renowned physicians will be given place, such as original manuscripts, autograph letters, portraits, etc. Information may be had by addressing Rush Medical College, Chicago.

The Berlin correspondent of the London *Times* states that the German government intends to have its customs officials instructed not only, as at present, in the superficial knowledge of the products of commerce and industry, but also in chemistry, physics and mechanical technology. It is also regarded as desirable that these officials should be acquainted with the elements of finance, of commercial policy and of commercial geography. At the most important customs offices in every province a laboratory, together with a library of technical books, will be established, where the minor officials will receive technical instruction from the customs officers of higher rank. These higher officials will themselves be trained in a great laboratory and auditorium which it is proposed to build at the chief customs office for foreign goods in Berlin. The teachers in this establishment will in part be professors of the technical colleges and kindred institutions in the German capital.

UNIVERSITY AND EDUCATIONAL NEWS.

The daily papers state that the Lawrence Scientific School of Harvard University will receive a very large sum from the estate of the late Gordon McKay, but there is, as yet, no official confirmation of this report.

By the will of the late Miss Mary T. Ropes, Harvard University will ultimately receive the endowment of a chair of political economy and a scholarship. Money for a chair of modern languages and a scholarship goes to the New Church University, a Swedenborgian institution at Albano, Ohio.

By the will of the late Dr. George Haven, the Harvard Medical School will ultimately receive $25,000 and half the residue of the estate.

Mr. J. B. Whittier, of Saginaw, has given $4,000 to the University of Michigan for a fellowship in botany.

It is announced that registration statistics for the year at Harvard show a total of 4,291 students in all departments, an increase of 65 over last year. The graduate school shows an increase of 83, while the college and scientific school show decreases of 37 and 19, respectively. The freshman class numbers 673, somewhat less than last year.

The freshman class at Yale University numbers this year 707, an increase, as compared with last year, of 69 in the Sheffield Scientific School and 39 in the Academic Department.

Five Rhodes scholars from South Africa began residence at Oxford at the beginning of the present term. They enter as ordinary undergraduate students, reading for the B.A. degree.

Dr. C. K. Edmunds, Ph.D. (Johns Hopkins), has been appointed professor of physics and electrical engineering at the Christian College in Macao, China.

At Trinity College, Cambridge, fellowships have been awarded to Mr. J. E. Wright, senior wrangler, mathematical tripos, 1900, and to Mr. H. A. Webb, bracketed third wrangler, 1902.